U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF SOILS—MILTON WHITNEY, Chief.

SOIL SURVEY OF THE OWOSSO AREA, MICHIGAN.

BY

A. W. MANGUM AND CHARLES J. MANN.

[Advance Sheets—Field Operations of the Bureau of Soils, 1904.]

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1905.

[PUBLIC RESOLUTION—No. 9.]

JOINT RESOLUTION Amending public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, "providing for the printing annually of the report on field operations of the Division of Soils, Department of Agriculture."

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, be amended by striking out all after the resolving clause and inserting in lieu thereof the following.

That there shall be printed ten thousand five hundred copies of the report on field operations of the Division of Soils, Department of Agriculture, of which one thousand five hundred copies shall be for the use of the Senate, three thousand copies for the use of the House of Representatives, and six thousand copies for the use of the Department of Agriculture: *Provided*, That in addition to the number of copies above provided for there shall be printed, as soon as the manuscript can be prepared, with the necessary maps and illustrations to accompany it, a report on each area surveyed, in the form of advance sheets, bound in paper covers, of which five hundred copies shall be for the use of each Senator from the State, two thousand copies for the use of each Representative for the Congressional district or districts in which the survey is made, and one thousand copies for the use of the Department of Agriculture.

Approved, March 14, 1904.

[On July 1, 1901, the Division of Soils was reorganized as the Bureau of Soils.]

CONTENTS.

ILLUSTRATIONS.

TEXT FIGURE.

MAP.

SOIL SURVEY OF THE OWOSSO AREA, MICHIGAN.

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LOCATION AND BOUNDARIES OF THE AREA.

The area surveyed embraces the northern eight townships of Shiawassee County, which is situated in the central part of the lower

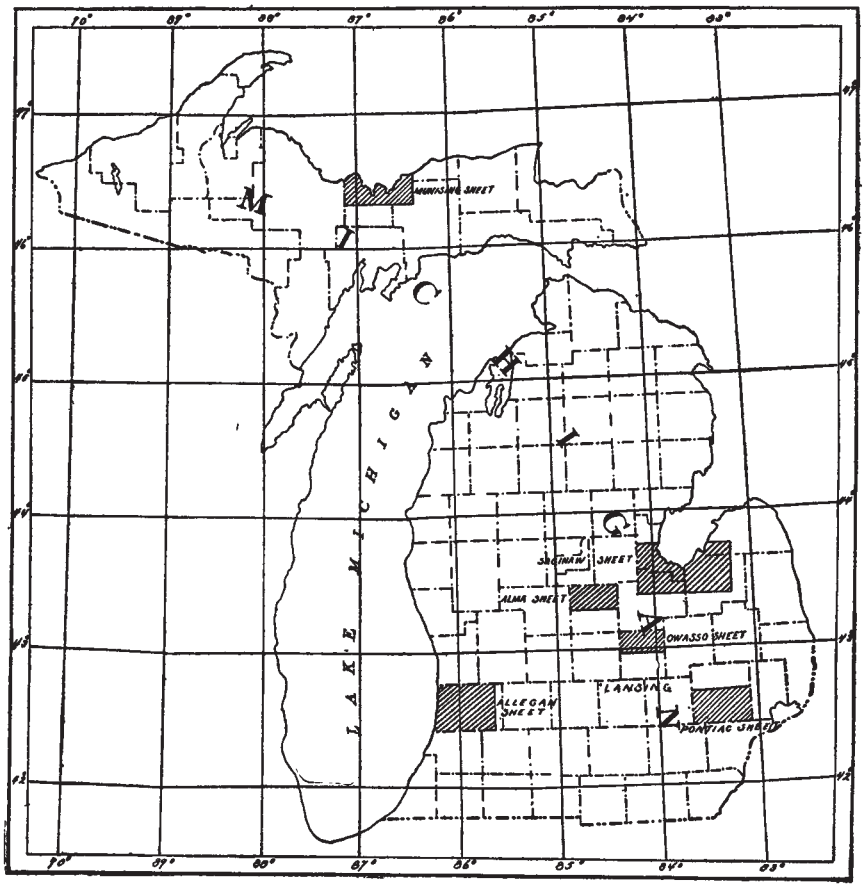

FIG. 1.—Sketch map showing location of the Owosso area, Michigan.

peninsula of Michigan. From the fact that the two western townships, Fairfield and Middlebury, are smaller than the others, the

total area of the eight townships is but 270 square miles. The area is bounded on the north by Saginaw County, on the east by Genesee County, on the west by Clinton County, and on the south by Scioto, Bennington, Shiawassee, and Vernon townships of Shiawassee County.

The first principal meridian extends along the western boundary, between Clinton and Shiawassee counties.

HISTORY OF SETTLEMENT AND AGRICULTURAL DEVELOPMENT.

Shiawassee County was organized in 1822, although at that time the white population consisted of only a few trappers and fur traders. From that year until 1835 the settlement of the region was very slow and, indeed, a part of the county territory was held by the Saginaw Indians until 1842.

Settlement was not retarded so much by Indian occupation, however, as by the character of the lands, which were heavily timbered, and by the lack of roads, travel over the trails used by the Indians being slow and difficult. In 1835 a large number of settlers began to arrive from New York, Massachusetts, Vermont, and other Eastern States, as well as from many of the older settlements in eastern Michigan. The greater number of these immigrants came from New York.

The first care of the pioneer settlers was to grow such crops as would provide their families with the necessaries of life, and wheat, being well adapted to the climatic conditions and soils, was at first the only crop cultivated. Later potatoes and corn were introduced and cultivated to a limited extent, but almost all the cleared lands were devoted to wheat. The yield obtained soon exceeded the local demand, and the farmers began to realize annually a small income from the sale of a part of the crop. The great distance to the markets, together with the large yields annually obtained, kept the prices low, and the profits were at first small. As the population of the county was yearly increased by the arrival of new settlers from the Eastern States, larger tracts of land were cleared and cultivated, and a greater diversity of crops was grown.

In 1850 an agricultural society was established for the purpose of holding annual fairs, at which the general farm products of the area were exhibited, but very little interest was manifested in this society until it was reorganized in 1860.

In 1850 the total number of occupied farms in the county was 746, and of the total area 31,203 acres were classed as improved. In 1874 the number of acres of improved land had reached 118,781, and in 1900 it was 260,650. The population of the county had also increased from 5,233 in 1850 to 33,866 in 1900.

In 1856 the first railroad reached the area. This was the Detroit and Milwaukee line, later the Detroit, Grand Haven and Milwaukee Railway, now a part of the Grand Trunk system. This road entered the county in Vernon Township, and extended west as far as Owosso. In 1862 the Amboy, Lansing and Traverse Bay Company opened a road to Owosso, which eventually came under the control of the Michigan Central Railroad Company. These roads, together with the Toledo, Ann Arbor and Northern Michigan and the Cincinnati, Saginaw and Mackinaw railroads, which also traverse the area, connect all parts of the county with important points, both north and south, and have been important factors in the development of the area.

The growth and agricultural development of Shiawassee County has been slow but steady. A large proportion of the tillable lands of the area is at present under cultivation, and a great variety of crops is grown. The cultivation of wheat has been the foundation of the agricultural wealth and prosperity of the area, and wheat has continued to be the most important product of the county up to within the last few years, since which time failures to obtain profitable yields have greatly decreased the acreage devoted to it.

CLIMATE.

The following table, compiled from records of the Weather Bureau, gives the normal monthly and annual temperature and precipitation of Shiawassee County. The records were taken at Ovid, in the western part of the county, and at Flint, situated a short distance east of the area. They are believed to represent fairly the climatic conditions of the whole county.

Normal monthly and annual temperature and precipitation.

Month.	Ovid.		Flint.		Month.	Ovid.		Flint.	
	Temperature.	Precipitation.	Temperature.	Precipitation.		Temperature.	Precipitation.	Temperature.	Precipitation.
	° *F.*	*Inches.*	° *F.*	*Inches.*		° *F.*	*Inches.*	° *F.*	*Inches.*
January	22.5	1.82	22.2	1.54	August	67.9	2.23	67.6	2.36
February	21.2	2.25	20.8	1.42	September	60.8	2.26	61.2	2.60
March	30.0	3.20	29.9	1.71	October	48.8	2.29	48.9	1.91
April	45.6	2.16	45.3	1.91	November	36.4	2.66	35.9	2.61
May	56.2	3.66	56.1	3.65	December	27.4	2.09	27.0	1.79
June	67.5	3.21	66.2	2.86	Year	46.3	30.98	45.9	27.32
July	71.2	3.15	70.1	2.96					

The following table gives the dates of first and last killing frosts, as observed by the Weather Bureau at Ovid and Flint during the period 1896 to 1903. These data represent fairly the conditions in

the area surveyed, and show that there is an average period of about five months during which vegetation is free from damage by frosts.

Dates of first and last killing frosts.

Year.	Ovid.		Flint.	
	Last in spring.	First in fall.	Last in spring.	First in fall.
1896	Apr. 22	Sept. 23	Apr. 22	.....
1897	Apr. 19	Sept. 21	.....	Sept. 21
1898	May 6	Oct. 29	May 7	Sept. 11
1899	.....	Sept. 14	.....	.....
1900	May 5	Oct. 17	.....	Oct. 17
1901	Apr. 20	Sept. 19	Apr. 21	Oct. 4
1902	May 28	Oct. 10	May 15	Oct. 10
1903	May 8	Oct. 18	May 4	Sept. 29
Average	May 3	Oct. 4	May 2	Sept. 30

PHYSIOGRAPHY AND GEOLOGY.

There are two general physiographic divisions in the Owosso area. The northeastern half of the area lies within the old basin of glacial Lake Saginaw, while the remainder is composed of rolling upland. Within these two divisions the topographic features are varied. The basin of the old glacial lake has the general appearance of a level plain, but low rounded knolls and ridges, with shallow depressions intervening, give it a gently rolling topography. Along the Shiawassee River, which traverses this section in a northerly direction, the topography is more broken. Here the greatest amount of erosion has taken place. The stream valley is often narrow and deep, and the slopes of the rounded knolls and ridges are usually steep and excessively drained.

In the extreme northern portion of the part of the basin included in the survey a series of narrow ridges of sand and gravel extends east and west from near the eastern to the northwestern boundary of the county. These ridges are seldom more than one-fourth of a mile wide, and are probably the remains of an old beach line.

The upland division is very rolling and uneven, the result of glaciation. The rounded hills and ridges extend across the area in a general northwest to southeast direction. The slopes gradually become steeper and more broken as the southern boundary of the area is approached, but they are never so steep as to interfere with cultivation.

Along the southern boundary, especially in the south-central part of the area, the topography becomes more typical of the glacial moraine. Sharp drift knolls of sand and gravel, with kettlelike depressions and small shallow basins intervening, are scattered at short intervals over this part of the uplands. There are some large gravelly areas near Ovid, in the southwestern part of the area, which are in many respects similar to the region last described. The topog-

raphy is quite rolling, and sharp knolls and narrow ridges occur frequently. However, the shallow depressions between them, unlike those in the "kame and kettle" topography, have a gentle slope toward the small streams and are well drained.

Extending across the southern part of the area, from east to west, is a well-defined valley of an ancient glacial stream, having an average width of one-half to three-fourths of a mile. This valley leaves the county near Ovid, in the southwestern part of the area surveyed. Its surface is comparatively level, the gentle swells and better drained areas consisting mostly of sand and the depressions usually of peat or muck. The southern escarpment of the valley is usually steeper and more clearly defined than the northern, often rising many feet above the level of the small streams or swampy depressions that now occupy the old channel. Deposits of rounded, waterworn gravel occur on the steeper slopes and low ridges on each side of the valley.

A second old stream channel enters the area in the extreme southern part of Owosso Township and joins the former near the southern boundary of the area. Another prominent topographic feature of the area consists of two depressions, together comprising about 8 square miles, occurring in the northwestern part of the county. These areas, surrounded by the rolling uplands, are poorly drained, and are now occupied by extensive peat bogs. Other smaller areas of a similar character occur in various parts of the county.

When the ice covered the northern part of the area, the drainage was probably westward through an ancient stream which followed the broad, shallow valley already described, but as the ice sheet receded the drainage of the greater part of the area was toward Lake Huron, and the streams cut their channels northward, finally reaching the lake at Saginaw Bay. The Shiawassee River flows through the old stream valley from east of Corunna to the city of Owosso, at which point it turns northward and runs in a deep, narrow channel, which it has carved out between the rounded hills in comparatively recent time. The rolling hills of the west-central part of the area form a divide for the drainage of the county. The eastern three-fourths of the area, with the exception of the northeastern portion, is drained by the Shiawassee River and its small tributaries. This river is the principal stream of the county, and flows across the area in a general northwest course, finally emptying into the Saginaw River. The southwestern part of the area is drained by the Maple River, which occupies the western part of the valley eroded by the old glacial stream, finally emptying into the Grand River, whose waters eventually reach Lake Michigan. Misteauguay Creek, which drains the greater part of Hazelton and Vernon townships, leaves the area in the extreme northeastern corner and empties into the Flint River.

The valleys formed by the streams since the ice invasion are deep and narrow. The steep slopes extend to the immediate banks of the stream, and there is practically no bottom land or alluvial deposit along their course. Small glacial bowlders are scattered over all sections of the area, but they never occur in sufficient number to affect the agricultural value of the land.

The geological formations of the area belong to the Carboniferous period, but they are covered to varying depths by glacial drift. There is a small exposure of the underlying sandstone near the river bluff a few miles east of Corunna, but the drift at the coal mines, a few miles north, ranges from 10 to 30 feet in depth, while at some other points in the county it is estimated to be over 100 feet deep.

There are three coal mines located a few miles northeast of Corunna, only one of which is being worked at present. Deposits of clay, suitable for the manufacture of Portland cement, occur in the same locality, and these are now being worked to a limited extent.

SOILS.

Nine types of soil, including Meadow and Muck, are found in the area surveyed. The following table gives the actual and relative extent of each type.

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Clyde loam	71,744	41.5	Meadow	2,688	1.6
Miami clay loam	62,464	36.1	Miami fine sandy loam	2,624	1.5
Miami gravelly sand	14,080	8.1	Saginaw sandy loam	1,280	.7
Miami fine sand	7,808	4.5			
Muck	6,400	3.7	Total	172,800	
Miami sand	3,712	2.1			

CLYDE LOAM.

The Clyde loam is the most important soil type mapped in the survey, both as to extent of area and agricultural value. It is more uniform as to depth, texture, and topographic features than any other type in the area. The soil consists of about 10 inches of heavy black to dark-brown loam, which contains a sufficient amount of silt and clay to give it many of the characteristics of a heavy silt or clay loam. The dark color of the soil is due to the organic matter always present in large proportions, varying slightly with differences in topography. The lighter colored areas, occupying the gentle swells, contain the smaller amount, while in the depressions, where the soil is of a very dark brown to black color, there have been heavier accumulations of humus.

The first few inches of the subsoil consists of a very heavy light-brown slightly mottled clay loam, the clay content gradually increasing and the soil becoming stiffer and more tenacious with depth. From about 25 to 36 inches it is a slightly mottled heavy clay loam or clay, but still contains a small percentage of sand.

When properly cultivated the soil breaks up into a loose friable loam, the sand content, together with the large amount of organic matter present, giving it a very desirable tilth. The surface becomes baked and sun-cracked when not under cultivation, and if plowed in a wet condition hard clods are formed, making it very difficult to reduce the soil to a state of thorough cultivation.

A few small areas of the Clyde loam, occupying the level depressions between the narrow gravel ridges in the northern part of the county, contain a slightly higher percentage of sand in both soil and subsoil than is present in the greater part of this type. This is due to the washing in of sand from the neighboring ridges and to the deposition of a larger amount of sand near the base of the old beach lines.

The Clyde loam extends in one broad area from the extreme northwestern part of the county to the southeastern boundary of the area, and occupies the greater part of Hazelton, New Haven, and Rush townships, and the northern part of Fairfield and Caledonia townships. It also occurs in smaller areas in every township surveyed. Small patches of sand or other soils occur at intervals scattered through the larger area, but it is broken only by a narrow strip of Miami clay loam which extends along the course of the Shiawassee River.

This soil occupies the most level portion of Shiawassee County, which is believed to be the basin of an ancient lake. The principal topographic features consist of low rounded knolls and gentle swells, with broad flat areas or shallow depressions lying between them. Where the topography becomes more rolling or broken the soil becomes lighter and grades into the Miami clay loam or into the small sandy areas which occupy the higher ridges and elevations. The natural drainage furnished by the topography is sufficient to carry off the excess water during times of heavy rainfall, and only the lower depressions remain in a condition too wet for cultivation for any considerable length of time.

The heaviest phase of the type is found in these low, poorly drained depressions. Here, under wet conditions, finer material, washed in from the more rolling areas, has combined with an accumulation of organic matter and formed a black loam that is slightly heavier than the typical soil. Such conditions, however, exist only in one or two small areas near the boundaries of the larger tamarack swamps, where the natural drainage is very poor.

The lighter phase occurs on the summits of the knolls and ridges where the soil is thoroughly drained and only a small percentage of organic matter is present.

A number of drains have been constructed through the more level areas of this type, but tile drainage is at present practiced only to a very limited extent.

As already pointed out, the old glacial Lake Saginaw once covered the section of the area occupied by the Clyde loam, and the material from which the soil is formed was deposited in this lake. The large amount of organic matter found in the soil probably owes its origin to the swampy and poorly drained condition that existed in this part of the area during the period following the subsidence of the lake.

This soil is better adapted to the growing of sugar beets than any other type in the area, and is also well adapted to wheat, oats, corn, and all general farm crops grown in this part of the State. The average yields are as follows: Corn, about 80 bushels of ears, although a yield of 100 bushels per acre is quite often obtained; wheat, up to within the last few years, about 18 bushels per acre, but the average for the last two or three seasons is less than 12 bushels per acre, while the crop for the present season (1904) is estimated at a still low figure; oats, from 40 to 50 bushels: pea beans or navy beans, which are extensively cultivated, from 18 to 20 bushels per acre, and sugar beets, when well cultivated, from 10 to 20 tons per acre.

The following table gives the results of mechanical analyses of typical samples of this soil:

Mechanical analyses of Clyde loam.

No.	Locality.	Description.	Fine gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
11526	SW. ¼ sec. 11, Venice Tp.	Loam, 0 to 10 inches	0.4	3.4	6.3	24.9	22.5	26.5	15.8
11522	Sec. 16, New Haven Tp.	Dark heavy loam, 0 to 10 inches.	.6	3.0	4.9	17.2	17.4	36.0	20.8
11524	NE.cor. sec. 13, Rush Tp.	Dark heavy loam, 0 to 10 inches.	.4	2.9	5.2	20.2	18.2	29.4	23.6
11523	Subsoil of 11522	Clay loam, 10 to 36 inches.	.8	3.6	5.2	17.3	14.7	31.6	26.6
11525	Subsoil of 11524	Heavy clay loam, 10 to 36 inches.	.6	3.1	3.8	17.4	17.4	27.5	30.1
11527	Subsoil of 11526	Heavy clay loam, 10 to 36 inches.	.7	2.3	3.5	13.4	15.5	33.2	31.3

The following sample contains more than one-half per cent of calcium carbonate ($CaCO_3$): No. 11522, 1.1 per cent.

MIAMI CLAY LOAM.

The Miami clay loam is the second soil of the area, both in extent and agricultural importance. The soil is a light-brown or yellow loam, made up principally of the finer grades of sand and silt, but containing enough heavy material to give it coherence and cause it to lump and clod to a considerable degree. At a depth of 6 or 7 inches a thin layer of light-colored, friable, silty material separates the soil from the true subsoil. The subsoil, from 10 to 36 inches, is a reddish-brown or yellow clay or clay loam, in which particles of coarse sand and occasional gravel are present. The upper 4 or 5 inches are usually friable and silty, but the material gradually becomes stiffer and heavier as the depth increases. Upon drying the surface of the soil assumes a light-yellow, or almost white appearance, and where the hillsides have been slightly eroded it has a light-brown color, due to the fact that the underlying subsoil has been brought near the surface and turned up with the plow.

The soil contains a moderate quantity of organic matter, though much less than the Clyde loam. Where it borders the latter type, in areas less rolling than the average, and where it occupies the slight elevations in the more level parts of the county, the percentage of humus is higher and the soil of a darker shade.

Gravel and small bowlders frequently occur, scattered over small areas, but are seldom so numerous as to interfere with the cultivation of the soil. In most cases the stones and small bowlders have been gathered into piles or removed from the fields.

Small ridges and knolls of sand or gravel occur at intervals throughout the entire area embraced by this soil type, and where these are of sufficient size they have been indicated on the soil map. A large number, however, do not exceed an acre in extent. In like manner, small areas of Clyde loam frequently occur in the shallow depressions, where an accumulation of organic matter and poor drainage have given rise to a heavier black soil.

The Miami clay loam occurs in one unbroken area extending from the southeastern to the northwestern boundary of the area surveyed. Small areas, occupying slight knolls and ridges, occur in every township, but on the whole the type is confined to the more rolling uplands and the broken country along the course of the principal streams.

The topography varies from gently undulating to rolling, but the slopes are never steep enough to interfere with cultivation or to cause the soils to suffer seriously from erosion. Low, rounded hills, with gentle slopes and prominent knolls and ridges, which indicate the glacial origin of the soil, are the principal physiographic features of the type.

The Miami clay loam is derived from the weathering of the glacial drift, which in this section of the area covers the underlying geo-

logical formations to a great depth. The material making up the deep subsoil consists mainly of a mottled silt and clay, containing considerable sand and an occasional pebble or small bowlder. The subsoil holds moisture very well, and in some cases is so stiff that it is difficult for water to percolate through it. In such cases tile drainage would be very beneficial. Where a good system of underdrainage has been established crop values have been greatly increased. In general, the rolling topography furnishes an adequate means for carrying off the surface waters, and there would seldom be any difficulty in finding a convenient outlet for a system of tile drainage.

The soil is well adapted to beans, and, when well cultivated, gives profitable yields of corn, oats, wheat, and hay. It is not so well adapted to the production of sugar beets as the Clyde loam, but under favorable conditions fair crops are obtained. When beets are to be grown an area should be selected where the soil is uniform and the topography is comparatively level, in order that the cultural needs of the various parts of the field should be as nearly as possible the same at the same time of the season.

Under ordinary conditions a yield of 35 bushels of corn per acre is obtained year after year, and it is not uncommon for this soil to produce 40 or 45 bushels per acre during a favorable season. The yield of wheat has been low during the last four years, but from 15 to 18 bushels per acre is considered an average yield in a favorable season. Oats yield on an average 40 bushels, and beans from 18 to 20 bushels per acre. Clover and timothy are usually sown together, and yield from 1½ to 2 tons of hay per acre. Sugar beets are not extensively grown. From 8 to 10 tons per acre is estimated to be the average yield.

The following table gives the results of mechanical analyses of the fine earth of the soil and subsoil of the Miami clay loam:

Mechanical analyses of Miami clay loam.

No.	Locality.	Description.	Fine gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
11498	Sec. 6, New Haven Tp.	Gray silty loam, 0 to 12 inches.	1.2	2.5	4.3	18.0	20.4	44.1	9.2
11500	SE. cor. sec. 30, Venice Tp.	Gray loam, 0 to 10 inches.	5.0	7.1	7.7	19.7	11.6	30.2	18.5
11499	Subsoil of 11498	Heavy loam, 12 to 36 inches.	.6	2.0	3.5	14.8	15.4	42.6	21.0
11501	Subsoil of 11500	Heavy clay loam, 10 to 36 inches.	1.6	3.4	5.0	13.7	10.5	29.4	36.3

MIAMI FINE SANDY LOAM.

The Miami fine sandy loam is one of the less important types of the area, covering in all only about 4 square miles. An average section would show a medium to fine sandy loam of a light-brown to yellow color, 10 to 12 inches deep, underlain by a heavier sandy loam that grades into a heavy clay loam. The subsoil is similar to that of the Miami clay loam, and in fact the same material underlies practically all the upland soils of this region. The section described above should be taken as an average, and not as the uniform soil condition over any very considerable areas. The soil on the crests of the knolls is generally more sandy, and the sand often extends to a depth of 2 or 3 feet. A small quantity of gravel is also occasionally found scattered through these more sandy areas of the type. On the slopes the heavy subsoil is nearer the surface, and the soil itself is less sandy. Such areas are very similar to the Miami clay loam, but as they occur only in patches of from a fraction of an acre to 3 or 4 acres in extent it was not practicable to indicate them on a map of the scale used.

The characteristic feature of this type is its topography, and the nature of the soil results largely from the surface peculiarities. Areas where the type occurs are marked by the "kame and kettle" topography, common in glaciated regions. Small, rounded knolls with intervening kettlelike depressions give the whole surface of the area a very broken appearance.

This soil for the most part is well drained, but many of the depressions have no natural outlet, and where they are of sufficient size give rise to small, marshy areas, unfit for cultivation. In other depressions a large amount of organic matter has accumulated, causing the soil to be of a darker color and slightly heavier texture. The higher knolls and steeper slopes are often too thoroughly drained, during a season of average rainfall, to give the best results with the crops cultivated.

The Miami fine sandy loam is of morainic origin, which accounts for its varied character. It is really a mixture of the materials composing the light sandy soils and the Miami clay loam, which have combined as a result of the peculiar nature of their occurrence.

A yield of about 60 bushels per acre of corn on the cob is obtained during a season of average rainfall, and for oats 40 bushels per acre is considered an average yield. Beans yield from 12 to 15 bushels per acre. Wheat is not well adapted to the conditions that exist in this section of the area, and is seldom cultivated. Clover and timothy produce from 1 to 1½ tons of hay per acre. The soil is well adapted to potatoes, and from 150 to 200 bushels per acre are obtained. It is also well suited to fruits, and small apple orchards, in a flourishing condition and annually producing large yields, are seen scattered over this area.

The following table gives the results of mechanical analyses of the soil and subsoil of this type:

Mechanical analyses of Miami fine sandy loam.

No.	Locality.	Description.	Fine gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
11484	SW. cor. sec. 36, Caledonia Tp.	Sandy loam, 0 to 12 inches.	3.2	6.7	8.4	24.5	17.1	28.5	11.3
11486	SW. ¼ sec 32, Caledonia Tp.	Brown sandy loam, 0 to 10 inches.	2.3	6.7	9.0	28.8	16.3	25.6	11.3
11487	Subsoil of 11486.....	Brown heavy loam, 10 to 36 inches.	1.0	5.0	7.7	22.6	14.6	23.3	25.8
11485	Subsoil of 11484.....	Clay loam, 12 to 36 inches.	1.2	5.0	6.8	19.2	14.7	26.8	26.3

MIAMI FINE SAND.

The soil of the Miami fine sand, to a depth of 12 inches, consists of a medium to fine sand of a light-brown to yellow color. The mineral particles form a loose and incoherent mass, but a small amount of humus in the first few inches of the surface soil gives it a slightly loamy texture. The subsoil, extending from 12 to 36 inches, is usually a loose yellow to red sand of about the same grade as the soil. On the lower slopes of the rounded knolls and where the type occupies small depressed or level areas the subsoil frequently becomes heavier at about 30 inches, in such places consisting of a sticky yellow or red sand.

Small areas of the Miami fine sand are found in almost every township surveyed, but its most frequent occurrence is in the northwestern part of the area, in Fairfield and Rush townships. The principal topographic features of these areas consist of low, narrow ridges or rounded elevations with gently sloping sides. This configuration gives the larger areas a slightly rolling appearance.

The loose, sandy character of the soil and subsoil, together with its topography, causes this type to be thoroughly drained, but in an average season a sufficient amount of moisture is retained in the soil for the production of the crops grown. Larger yields, however, are always obtained during wet seasons.

The sandy knolls and ridges formed of the Miami fine sand are made up of reworked glacial drift, deposited with the aid of water, and owe their origin either to the streams issuing from the ice sheet or to the deposition of material along the shores of the glacial lake.

The average yield of corn on this soil ranges from 20 to 25 bushels per acre; wheat yields 10 bushels; oats, about 25 bushels; and beans, from 10 to 12 bushels per acre. Potatoes and vegetables do well, and are well adapted to the soil. Clover and timothy produce fair yields. Sugar beets have been grown to a limited extent, and under favorable conditions yield from 7 to 10 tons per acre.

The following table gives the results of mechanical analyses of typical samples of the soil and subsoil of this type:

Mechanical analyses of Miami fine sand.

No.	Locality.	Description.	Fine gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
11510	NW. ¼ sec. 4, Rush Tp.	Loose fine sand, 0 to 12 inches.	0.0	1.8	16.6	67.5	6.9	3.9	3.4
11512	SE. cor. sec. 15, Fairfield Tp.	Sand, 0 to 12 inches.....	.1	6.9	17.3	43.0	14.6	12.3	5.5
11511	Subsoil of 11510.....	Fine sand, 12 to 36 inches.	.2	2.3	15.9	66.1	8.2	3.8	3.1
11513	Subsoil of 11512.....	Medium to fine sand, 12 to 36 inches.	.2	7.0	18.3	46.9	14.8	8.8	3.8

SAGINAW SANDY LOAM.

The soil of the Saginaw sandy loam is a black or dark-brown medium to fine sandy loam, with an average depth of 12 inches, and containing a very large proportion of organic matter. It is underlain by a thin layer of loose medium to fine sand of a whitish, bleached appearance. This grades into a gray sand of somewhat coarser texture, which becomes sticky as the depth increases and frequently contains a considerable proportion of clay. The subsoil is often slightly mottled with yellow or red iron stains, and thin layers of the stiff blue clay, which underlies the sand at no great depth, are sometimes encountered at a depth of from 20 to 36 inches.

The Saginaw sandy loam occurs in a few small areas in the northern part and in two small depressions in the southwestern part of the area. It covers in all an area of less than 3 square miles.

This soil occurs in small, shallow basins that have only recently emerged from a swampy condition, and where, even now, the drainage is insufficient. These depressions are almost entirely surrounded by low knolls and ridges, making it difficult to drain them thoroughly. The lower depths of the subsoil are usually in a wet, soggy condition, and a considerable portion of the whole type is too poorly drained to be of much agricultural value.

The Saginaw sandy loam has been formed by the accumulation of large quantities of organic matter in poorly drained, sandy depressions. The slowly decomposing organic matter has become mixed with the sand washed in from the neighboring slopes, and a black sandy loam soil is the result. In the more swampy depressions the soil has many of the characteristics of Muck.

Only a small proportion of the area of this soil is at present under cultivation, the greater part being used exclusively as pasture land; but where thoroughly drained fair yields of corn, oats, timothy and clover, and beans are produced. Wheat is rarely grown on these lands, as the yield is seldom large enough to make it a profitable crop.

Corn produces from 35 to 40 bushels; oats, from 25 to 30 bushels; timothy and clover, from 1 to 1½ tons of hay; and navy beans, from 8 to 10 bushels per acre.

The following table gives mechanical analyses of this soil:

Mechanical analyses of Saginaw sandy loam.

No.	Locality.	Description.	Fine gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
11508	SW. ¼ sec 3, Rush Tp.	Sandy loam, 0 to 10 inches.	1.8	9.6	16.4	47.4	6.7	13.7	4.4
11506	NW. cor. sec. 10, Fairfield Tp.	Black sandy loam, 0 to 18 inches.	2.5	11.5	24.1	37.6	6.1	11.7	6.3
11507	Subsoil of 11506	Sand, 18 to 36 inches	4.5	15.8	34.8	19.5	8.3	10.0	6.9
11509	Subsoil of 11508	Light gray sand, 10 to 36 inches.	.4	2.8	12.4	47.8	12.8	16.2	7.0

MIAMI GRAVELLY SAND.

The Miami gravelly sand consists of a gray to light-brown sand or sandy loam about 12 inches deep, and containing a high percentage of gravel, underlain by a medium to coarse yellow or red sand, also carrying a large proportion of fine and coarse gravel. The material composing the subsoil is cemented, it is believed, with iron, and often consists of a compact mass of sand and gravel, with many of the characteristics of a hardpan, although it is never so hard as to prevent the penetration of plant roots.

Small sandy areas occur in this type where the gravel content of the surface soil is low and where the sand has been deposited to a greater depth above the coarser material forming the subsoil. These areas occupy the shallow depressions or more level areas between the sharp

knolls and ridges. The contrary is true of the steeper slopes and ridges along the stream courses, and small areas occur at frequent intervals where from 30 to 40 per cent of the surface is composed of gravel. The stone particles vary in size from coarse sand to cobbles several inches in diameter. On most of the narrow ridges the finer sand particles are gradually being washed down to the lower levels, leaving the coarser material exposed on the surface, and causing a deeper accumulation of sand along the lower slopes.

The Miami gravelly sand occupies long, narrow ridges in the northern part of the area, and also the steeper slopes bordering the larger streams. It occurs most extensively in Middlebury Township, in the southwestern part of the area, but areas of smaller extent are found in the more rolling sections throughout the survey.

Although the topography is rolling, with frequent well-defined knolls and ridges, the slopes are gentle, except along the immediate banks of the larger streams, and the soil over the greater part of the area suffers very little from the effects of erosion. The topography and porosity of the soil insure good drainage. The areas occupying the steeper slopes are often too well drained, and the crops suffer to some extent from the effects of drought, but during a season of average rainfall sufficient moisture is retained in the soil occupying the rolling hills to supply the needs of the crops cultivated.

The areas of the Miami gravelly sand in the northern part of the county were probably deposited along the beach lines of the old glacial lake. The larger area in Middlebury Township is derived from the coarser material deposited here as glacial outwash, while the narrow strips along the old stream valley consist of the sand and gravel laid down along the banks of the old channel while it served as an outlet for the waters from the melting ice.

This soil is well adapted to fruits, and excellent yields are realized from the small orchards located on it. It also produces very profitable yields of beans and corn. Clover also does well, but the type is not well adapted to timothy. When well cultivated, the yields of all the general farm crops of the area compare very favorably with those obtained from the heavier types of soil. Corn yields an average of 60 bushels of ears per acre, and wheat, in an average season, from 12 to 15 bushels per acre. Oats are considered a sure crop, and give an average yield of from 35 to 40 bushels per acre. Clover and timothy are usually sown together, and the average yield of hay is about $1\frac{1}{2}$ tons per acre. Beans do well, and yields of from 15 to 18 bushels per acre are annually realized. Very few sugar beets are grown, but a fair yield has been obtained on the limited areas cultivated to them. Potatoes yield from 150 to 200 bushels per acre, and other vegetables do exceedingly well.

The following table gives the results of mechanical analyses of typical samples of fine earth of the soil and subsoil of the Miami gravelly sand:

Mechanical analyses of Miami gravelly sand.

No.	Locality.	Description.	Fine gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
11492	NE. cor. sec. 12, New Haven Tp.	Sand, 0 to 12 inches	6.4	21.7	26.3	29.6	5.3	6.8	3.7
11490	SE. cor. sec. 35, Middlebury Tp.	Brown sandy loam, 0 to 10 inches.	3.7	18.0	15.6	25.8	10.0	20.8	5.8
11493	Subsoil of 11492	Red to brown sand, 12 to 36 inches.	4.9	19.4	27.1	38.6	3.2	3.3	3.2
11491	Subsoil of 11490	Sand containing gravel, 10 to 36 inches.	7.9	36.1	20.7	18.1	4.7	5.9	6.6

MIAMI SAND.

The surface soil of the Miami sand is a dark-brown to gray loamy sand, the color varying in proportion to the amount of organic matter it contains. The sand is mostly of medium and fine grades, but, as is common with soils of similar origin, small areas of a coarser or finer texture also occur. At an average depth of 12 inches the soil grades into a sand of slightly coarser texture, which varies in color from light yellow to red. Gravel, clay, or sticky sand underlies this sand at a depth of 3 feet or more, and thin bands of clay or gravel are often encountered at a depth of 25 or 30 inches.

This soil occurs in a few small areas along the old glacial stream valley that extends across the southern part of the area, and is of minor importance, both in extent and agricultural value. The largest area occurs just north of Corunna, in that part of the old valley now occupied by the Shiawassee River.

The topography is comparatively level, with gentle swells and shallow, basinlike depressions. One or two well-defined terraces of the old river channel occur in the larger area of the type.

The level and gently undulating areas are comparatively well drained, but in many of the shallow depressions the drainage is very poor, and accumulated organic matter has become mixed with the sand, producing small mucky areas unfit for cultivation. These areas are of very small extent, and are not indicated on the map. The materials of the Miami sand really occupy the greater part of the old stream valley, but where the drainage has been insufficient they have been buried under an accumulation of peat or are in a condition too wet and swampy for agricultural purposes. Only those

areas that have been thoroughly drained by the Shiawassee or Maple River have been shown on the map as the Miami sand.

The sand, gravel, and finer material composing this type were deposited in the bed of the old glacial stream which geologists believe occupied this valley soon after the ice invasion, and the small areas of gravel and coarse material which frequently occur were deposited in the swifter currents of the ancient stream. The alternate layers of coarse and fine material sometimes encountered in the subsoil, and the beds of gravel or clay that occur at varying depths below the soil profile, also point to alluvial deposition as the origin of this soil.

The Miami sand is well adapted to truck, and large areas could be profitably utilized in growing vegetables for the local markets. Potatoes are also well suited to this soil, and always produce large and profitable yields. The soil is not well adapted to the general farm crops, and the yields obtained are small as compared with those produced on the heavier soils. The crops grown and average yields are as follows: Oats, 30 bushels per acre; beans, from 8 to 10 bushels; corn, 20 bushels, and potatoes, from 150 to 200 bushels per acre. A moderate yield of hay is secured, but wheat is seldom grown, as the yields are very small.

The following table gives the results of mechanical analyses of samples of fine earth of the soil and subsoil of this type:

Mechanical analyses of Miami sand.

No.	Locality.	Description.	Fine gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0 mm.
			P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.
11516	Sec. 23, Middlebury Township.	Light loamy sand, 0 to 12 inches.	3.1	9.2	14.7	43.9	11.9	13.0	3.8
11518	Sec. 19, Caledonia Township.	Brown to gray sand, 0 to 8 inches.	2.8	12.8	18.9	32.0	15.7	12.5	5.4
11517	Subsoil of 11516	Loose sand, 12 to 36 inches.	1.9	10.2	16.2	41.2	13.0	12.5	5.2
11519	Subsoil of 11518	Sand, 8 to 36 inches.	6.5	15.5	19.8	29.7	13.9	8.0	6.3

MEADOW.

The soils mapped as Meadow consist of poorly drained areas occurring along the streams, usually in a condition too wet for cultivation. These areas are composed of a variety of materials that have been washed in from the rolling uplands or deposited by the streams and incorporated with varying proportions of organic matter in different stages of decomposition.

The small areas occupying the slight elevations are often sufficiently drained to permit cultivation, but the greater proportion of

the Meadow consists of small areas of peat, muck, sand, and clay so intermingled that it was impracticable to attempt to map them in separate classes, and in such a poorly drained condition that they are suitable at best only for pasture land.

MUCK.

Two large depressions in the western part of the area have been classified as Muck. The surface is usually dry and of a brown color, but as the depth increases the material becomes more or less saturated with water, is black in color and mucky in texture. The depth of the accumulated organic matter ranges from 2 to more than 10 feet.

These areas occupy basins surrounded by rolling hills, and do not have outlets affording adequate drainage. They are now covered by a heavy growth of tamarack and a species of poplar. The surface deposits are usually underlain by a light-colored sand, which resembles the subsoil of the Saginaw sandy loam. Another area of considerable size occurs in that part of the old stream valley which has been only partially drained by the small stream now occupying it, and areas of smaller extent are found in various places throughout the territory embraced by the survey.

At the present time the areas of Muck are of little agricultural value. Considerable areas have been burned off, leaving the underlying sand exposed on the surface. If properly managed and more thoroughly drained, the areas of this soil type would be valuable for the production of potatoes, onions, celery, and garden truck.

AGRICULTURAL METHODS.

The agriculture of the Owosso area belongs to the class usually designated as "general farming." A variety of crops is grown, and the work is well distributed throughout the season, so that it can be accomplished without the aid of much hired labor. On a farm of only 80 acres as many as five or six distinct farm crops may be grown, leaving besides a considerable acreage allotted to timber land, pasture, orchard, and garden. The rotation of these crops on a single field requires a period of from four to seven years with the following commonly practiced system: First year, corn or beans; second year, corn or beans; third year, oats, barley, rye, or wheat; fourth year, rye or wheat; fifth, sixth, and seventh years, hay. Although this is a long system of rotation and one that would scarcely do if some special crop demanded greater acreage, it has doubtless been one of the chief factors in maintaining the productiveness of the soils.

The plowing is usually done in the fall, the soil being turned to a depth of 6 or 8 inches and allowed to lie in that condition until spring opens, when it is smoothed down with a spring-tooth harrow, pulverizer, or disk. If the soil has become clodded and is difficult to reduce to a good tilth, the roller is also used.

Corn is usually planted between May 20 and June 10. The seed, generally home grown, is dropped in check rows from 3 to 4 feet apart. Cultivation begins with the weeder, which is used until the plants are 4 or 5 inches high. A cultivator is then used from three to five times before the crop is laid by. Harvesting takes place during the latter part of September.

A larger acreage is probably given to the navy bean than to any other crop grown in the area. The beans are drilled in with the corn planter between May 10 and June 10. A slightly firmer seed bed is desired for this crop than for corn, and this is secured by a more thorough harrowing and rolling. The common practice is to leave the surface rolled smooth and hard, but this must result in a considerable loss of moisture by evaporation; and in many cases a hard crust is formed, through which it is difficult for the young plants to break. For these reasons the rolling should be followed by a shallow surface cultivation to form a mulch, which prevents the baking of the surface and also aids in the conservation of moisture. Soon after the beans appear cultivation begins, and the field is cultivated four or five times before the latter part of August. Then, after allowing from two to three weeks for the crop to mature, the plants are cut just beneath the surface with a bean harvester and allowed to remain in small piles in the field until they are dry. As soon as practicable they are placed under shelter to cure, as the crop is often considerably damaged if exposed to rain. When cured, the beans are thrashed and marketed. The hulls and remnants of the vines, together with beans of an inferior quality, which are repurchased from the elevators, are utilized as feed for sheep.

Oats usually follow corn or beans. In preparing the seed bed plowing is sometimes omitted, but usually precedes the work with the disk, drag, or harrow. As early as practicable, in most seasons about the middle of April, the seed is either drilled in or sown broadcast. Drilling usually gives better results, especially in a dry season. Oats are harvested during the latter part of August. As soon as the crop is removed the ground is plowed for wheat or rye. It is then harrowed and rolled to break up the clods. The seed is drilled in about the middle of September, and the crop is harvested in the latter part of the July or early in the August following. Formerly, when wheat was more extensively grown in the county, summer fallowing was commonly practiced.

Timothy and clover seed are usually mixed in the proportion of two-thirds timothy to one-third clover, and are sown with oats. Clover and timothy are included in almost every system of rotation practiced in the area, and a considerable quantity of hay is produced annually. The main hay crop is harvested in July, but a second cutting of clover for seed purposes is usually obtained in September.

The growing of sugar beets is a comparatively new industry in the area, and the methods employed in cultivating the limited acreage now devoted to their production are largely dictated by the agriculturists of the sugar-beet companies. The ground preferably is plowed in the fall and immediately rolled. It is allowed to remain in this condition until spring, when it is thoroughly harrowed and rolled again. Just before planting the seed the field is given another shallow surface cultivation. The seed are drilled in to depths varying from about one-half inch on the heavier to 2 inches on the lighter soils. If the surface becomes hard or crusted, it is loosened again with a drag or fine-tooth harrow to enable the young plants to break through without difficulty. When the beet plants are about two weeks old they are "blocked." This process consists of cutting out all but 2 or 3 inches of beet plants to each foot. The plants are thinned out by hand a short time after blocking and are cultivated frequently thereafter. Great care is necessary to keep the field entirely free from weeds. Beets are harvested in the latter part of September or in October and marketed at the local factories. A large proportion of the beet seed used is imported, but the seed from Washington are said to give a germination test about 20 per cent better than the foreign product.

In addition to the crops enumerated, almost every farmer has a small orchard. This is usually well cared for, and is sown either to bluegrass, field peas, or rape for hog or sheep pasture.

Very little commercial fertilizer is used in the area, but a large quantity of stable manure is applied annually to the oat stubble or sod land. There are a few manure spreaders in use, but the common method is first to distribute the compost in small piles over the field, and then to spread it more evenly over the surface by hand.

Drainage is secured by means of open ditches. These have been constructed at frequent intervals over the more level sections of the area. Tile drainage is not extensively practiced, but it has proved beneficial to the land, not only in wet but also in dry seasons. The idea that tiling the land will make it more susceptible to drought seems frequently to be held by the farmers. Such is not the case, for tiling, by lowering the water table in the soil early in the season, promotes the growth of a deeper root system, and when, later in the season, a drought occurs, the plants draw upon the deeper-lying supply of moisture, and suffer less than would be the case if moisture conditions, such as normally occur in undrained soils, had forced the growth of a shallow root system.

In general, more intensive farming, a more extensive use of tile drainage, and the specialization of crops best adapted to the various soils, are suggested as changes tending to improve the agriculture of the area.

AGRICULTURAL CONDITIONS.

The northern half of Shiawassee County, the area embraced by this survey, is comparatively thickly populated, and is well developed agriculturally. A large proportion of the total area, and especially where the Clyde loam occurs, is continuously under cultivation. The total acreage of farming lands in the entire county is given by the Twelfth Census as 334,895 acres, of which 260,650 acres consisted of improved lands. The soils are productive, and are well adapted to a diversity of crops, which are seldom seriously damaged either by droughts or excessive rainfall. The income derived from profitable yields annually obtained has placed the average farmer of the area in very good financial condition. The prosperous condition of the farming class throughout the area is well illustrated by the general character of the farm buildings. The typical dwelling house is a large two-story frame building, equipped with telephone and other modern conveniences. The outbuildings are neatly constructed and the surroundings well kept, giving to the whole an appearance of thrift and prosperity. The barns in all parts of the area, and especially those recently constructed, are large and generally painted. The practice of stacking the straw or hay and leaving it exposed to the weather during the winter months is going out of general use, and the barns are now being built of sufficient size to afford storage room for the straw, hay, grain, and all other products of the farm, as well as shelter for the stock and farming machinery during the winter months.

The majority of the farmers in the area own the lands they cultivate, but farming lands are occasionally rented for cash or farmed on shares. When a cash rental is paid the average rate is $3 an acre, but the majority of the landholders prefer to rent under the share system. One-third of the crop produced is generally asked when the landlord furnishes the land only, but where he furnishes everything except the labor two-thirds of the crop is taken.

The large tracts of land owned by the earlier settlers have been gradually divided into smaller farms, so that at the present time very few farms in the area exceed 120 acres in extent. There are a few small farms of 40 to 50 acres. The labor conditions of the area make it difficult for any one farmer properly to manage a large tract of land, and the average size of farms for the entire county, as shown by the Twelfth Census, is 89 acres. The larger farms usually contain some areas of small agricultural value, which are used as pasture for the sheep or other stock, but the farms on the Clyde loam and those situated near the principal towns are usually small.

Comparatively little hired labor is employed on the farms of this area, as the average farmer is able, with the aid of his family, to

care for the land he cultivates. The farm labor employed is of a very efficient character, and is usually available, except during the harvest season, when it is often difficult to obtain. The average wage by the day ranges from $1 to $1.50, but when hired for longer periods $22 a month with board is usually paid. The large amount of modern farming machinery in use throughout the area greatly reduces the number of laborers needed to carry on the farm work.

Since the early settlement of Shiawassee County wheat has been one of its most important agricultural products. A large yield was always realized, and for years the chief income of the farmer was derived from the sale of this crop. During the past three or four years the yield per acre has been much smaller than formerly, and the result has been a decrease in the acreage. The failure to obtain profitable yields is due both to unfavorable seasons and to the damage done by rust and insects. It is estimated that during the present season (1904) the acreage cultivated to wheat is considerably less than half what it was five years ago. Beans are now the principal money crop of the entire county. The navy bean is extensively cultivated on almost every farm, and profitable yields are obtained on every cultivable type of soil. There is a good demand for this product delivered in the local markets, where it usually brings about $1.25 a bushel.

Although the soils of the area annually give a large per acre yield of corn, the production of this grain is not sufficient to meet the local demands. No corn is shipped to markets outside of the area, and a considerable amount is annually imported from the West. The entire product is fed to stock, a large quantity being used to fatten sheep, which are shipped in from the West, and sent to Buffalo or other Eastern markets as soon as they are in good condition. The oats crop is seldom a failure, and although the larger yields are continuously obtained from the heavier loams, the lighter soils rarely produce less than 25 to 30 bushels per acre. The supply of hay produced greatly exceeds the local demand, and large quantities are annually baled and shipped to distant markets.

The growing of sugar beets, as already noted, is an industry of comparatively recent introduction into the area, and as yet the acreage devoted to their production is not extensive. Soon after the sugar-beet factory was established at Owosso plans were set on foot to introduce the crop throughout the entire county, but the inexperience of the farmers, the high prices paid for labor, and a very unfavorable season caused the experiment to result in a considerable financial loss to the beet growers. This failure greatly discouraged many of the farmers, causing them to abandon the crop, and also deterred many others from attempting its cultivation. However, a small acreage is cultivated to beets in all sections of the area, under the super-

vision of agriculturists employed by the factory, and there is every indication of a profitable yield during the season of 1904. Enough has been done to demonstrate that the sugar beet can be profitably grown in this part of Michigan, and the prospects are that it will eventually become one of the most important products of the area.

Buckwheat, rye, barley, potatoes, truck, and small fruits are all successfully grown on the various soil types best adapted to them. In 1899 the value of the orchard products alone, as returned for the entire county, amounted to $111,524.

As regards the general adaptation of the soils, the heavier loams are recognized as the soils best adapted to general farming purposes, and the larger yields of wheat, oats, hay, beans, sugar beets, and corn are produced on them. The more sandy soils are well adapted to potatoes, truck, and small fruits. The Clyde loam, owing to its level topography and natural productiveness, is the type best adapted to the growing of sugar beets, and the yield is estimated to be from 1 to 2 tons more per acre than that obtained on the lighter sandy soils or on those occupying the more rolling sections of the area. Potatoes and garden truck are occasionally grown with excellent results, both on the Saginaw sandy loam and on a few of the small, better-drained areas of Muck.

The county roads, connecting the local markets with all sections of the area, are kept in fairly good condition, and iron bridges have been constructed over the Shiawassee River and other principal streams. The four railroads traversing the area furnish adequate facilities for transportation.

Owosso, a city of about 10,000 inhabitants, situated in the southern part of the area, is the principal local market, but Corunna and Durand are also markets of considerable importance. The wheat and oats shipped out of the area go mainly to Detroit and Toledo, while the hay is shipped direct to Boston and other eastern cities. The sheep and hogs go to Buffalo, but the cattle are usually sold at Detroit. A large quantity of beans is annually exported to the larger markets in various sections of the country.

There are several creameries in the county, and these, together with the numerous towns, furnish a ready market for dairy products in all sections of the area.

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BUREAU OF SOILS
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SOIL MAP

MICHIGAN
OWOSSO SHEET

SOIL PROFILE
(3 feet deep)

- Miami gravelly sand — S, Sc
- Miami fine sand — S, Sc
- Miami sand — S, S
- Saginaw sandy loam — Ssc, Ssc
- Miami fine sandy loam — Ssc, Sc
- Miami clay loam — Sc, Scc
- Clyde loam — Sc, Hscc

LEGEND

- Gravelly sand
- Fine sand
- S Sand
- Ssc Sandy loam
- Sc Fine sandy loam
- Sc Loam
- Scc Clay loam
- Hscc Heavy clay loam

LEGEND

- Mg — Miami gravelly sand
- Mf — Miami fine sand
- Ms — Miami sand
- Sl — Saginaw sandy loam
- Mfs — Miami fine sandy loam
- Mc — Miami clay loam
- Cl — Clyde loam
- Mu — Muck
- M — Meadow

Soils surveyed by
A.W. Mangum and Charles J. Mann
1904

Scale 1 inch = 1 mile

Field Operations
Bureau of Soils
1904